

December 15, 1960

TO: S. E. Beall
FROM: 7500 Area Hazards Committee

HRP-148 Director's Files, 1960
Health Physics, Radiat
Exposure, Accidents
Folder, Shelf # 4

SUBJECT: RADIATION INCIDENT IN 7500 HIGH BAY AREA ON DECEMBER 10, 1960

1.0 SUMMARY

On Saturday, December 10, at noon, 10 persons received doses ranging from 0.42 to 2.51 R of penetrating radiation while engaged in moving an HRT diaphragm pump head from the reactor shield to the 7500 Area hot equipment storage pool. Radiation levels 4" from the carrier used to shield the pump were 120 R/hr. The whole operation took approximately 7.5 minutes with no serious mechanical difficulties arising. A detailed approved procedure was followed after a complete rehearsal of the mechanical operations. The principal shortcomings arose due to the activity level of the pump being much higher than had been anticipated. The level could have been established by lowering a gamma probe into the reactor for a direct reading on the pump.

The 7500 Hazards Committee¹ met on Monday, December 12, to hear a review of the operations relative to the pump transfer and suggestions on how similar radiation incidents can be prevented.² The material for this report was, in general, derived from this meeting.

2.0 PUMP REPLACEMENT - PLANNING AND DESCRIPTION OF OPERATION

The HRT was shut down on December 4, following detection of radioactivity in the containment shield gas. After a few days of investigations by the reactor operating group, all available evidence indicated that the east diaphragm head of the fuel feed pump had leaked about 1 liter of fuel solution though the head would not leak when tested under several conditions. The head was replaced and moved to the hot equipment storage pool so that it could be definitely established whether or not it had leaked. The operation, therefore, was considered quite important to the reactor project.

¹N. C. Bradley, Laboratory Shift Supervisor, served temporarily with the committee for this particular investigation.

²Present at the meeting were: M. A. Baker, S. E. Beall, N. C. Bradley, J. R. Buchanan, A. C. Butler, W. D. Burch, R. L. Clark, J. W. Hill, J. P. Jarvis, A. J. Miller, H. C. Roller, R. H. Winget.

This document has been approved for release to the public by

David R. Harris 12/15/95
Technical Information Officer
ORNL Site

2.1 Planning

A detailed procedure covering the pump transfer using a shield was written by J. P. Jarvis, program engineer, and approved by area supervision following normal practice.* It was anticipated that activity levels would be approximately 10 R/hr outside the shielded pump carrier [4' x 4' x 8' x 2" thick (1-1/2" lead + 1/2" steel)] and that personnel would receive no more than 1 week's dose of radiation. In accordance with Laboratory procedure, approval of work in the 10 R field was obtained from R. B. Briggs, Fluid Fuels Project Director. Previously, pumps were pulled unshielded using a different procedure whereby no one would have to approach the pump. It was felt, that by using the shield, the procedure for this operation would be better than before.

Direct gamma readings on the pump, which would have shown that the activity level was much higher than expected, were not taken when planning the operation. The permanently installed hi-level gamma monitor (mounted 10-12 feet above the pump) which read 1250 R/hr was consulted however. Its indicated level was no greater than readings taken during previous shutdown and was not felt to be alarming.

In an attempt to clean the pump in the best manner available to Operations, it was rinsed both inside and outside. Many gallons of D₂O were pumped thru the head. The pump exterior was sprayed with decontaminating solution (4% ammonium oxalate and 3% hydrogen peroxide) followed by two water rinses. A shield sump sample indicated that at least 40 curies of beta activity was washed to the sump.

2.2 Procedure

The plan was to pull the pump into a shielded carrier using the overhead crane while working thru a dry maintenance facility which covered an opening in the roof of the reactor shield. The pump was then secured inside the carrier and the crane transferred from the pump lifting rod to the carrier bail. At the same time a drip pan was to be secured under the carrier and the assembly moved approximately 50 feet to the hot equipment storage area where the pump was lowered underwater.

Primary jobs during the transfer were as follows. Two men were used on ropes to pull the drip pan, two men to open and close one end of the maintenance facility, one man to operate a switch which controlled the other end of the facility, two men to close angle bracket on top of carrier around pump lifting rod, one man to view thru mirror as pump was pulled to make sure it was clearing possible obstructions, two men to disconnect drip pan, two men to position carrier over storage pool and two men to remove pin from angle bracket and open it so that the pump could be lowered underwater. Many of these jobs were, of course, done by the same people.

The procedure was discussed in detail with all personnel to be involved in it. Following this, the entire operation was rehearsed. The

*See Appendix attached.

12/15/60

health physics monitor did not participate in the rehearsal.

2.3 Actual Pump Removal

The pump was removed essentially as intended with no serious difficulties.

As the pump was lifted into the carrier, [REDACTED] stood on a ladder viewing with a hand mirror held over the open top of the carrier to see that the pump cleared the maintenance facility. [REDACTED] got a radiation reading of 100 R/hr, which was not unexpected, thru the top of the carrier so he signaled [REDACTED] off the ladder. [REDACTED] and [REDACTED] climbed the ladder and closed the bracket. The carrier was lifted slightly while two men pulled the drip pan under the carrier. The pan had to be repositioned (taking about half a minute) by [REDACTED] and [REDACTED]

The carrier was lifted approximately 5' to clear the hand rails and moved to the storage pool area by the crane. [REDACTED] reported that he found it difficult to tell what the pump itself was reading when lifted into the carrier because of "shine and scatter" from the reactor shield. Not until the carrier was moved from the maintenance facility did he realize that the reading of approximately 120 R/hr at 4" from carrier was from the pump itself. He waved all personnel away at this time and informed [REDACTED] of the activity level. It was later estimated that approximately 4-5 minutes had elapsed since the start of the operation. [REDACTED] acknowledged and indicated that they would move rapidly to get the pump underwater.

At the storage pool, [REDACTED], [REDACTED] and [REDACTED] disconnected the drip pan and helped position the carrier. [REDACTED] then climbed a ladder and released the angle bracket and the pump was lowered into the water. Activity level above the water was only 400 mr/hr.

The entire operation had taken only approximately 7.5 minutes.

While the transfer was in progress, activity levels in the reactor control room had risen to 8-10 R/hr (approximately 15' from the shield) so all operating personnel retreated to the area front gate where the activity level was 70 mr/hr.

3.0 ACTIVITY LEVELS AND PERSONNEL EXPOSURES

When all direct reading dosimeters were found off-scale following completion of the operation, the badges of the 10 people involved were removed and the films developed. The total quarterly dose is noted for each person involved with the dose from the incident estimated by subtracting pocket meter readings for the period from these values.

Table 1

Person	Film Badge		Dose DP	Previous Dose-DP	Dose from the Incident - DP
	DM	DL			
██████████	1885	1670	1670	0	1670
██████████	1985	1935	1935	590	1345
██████████	635	585	585	25	560
██████████	1310	850	850	300	550
██████████	2650	2300	2300	390	1910
██████████	1320	1215	1215	110	1105
██████████	1230	1030	1030	245	785
██████████	3050	2675	2675	170	2505
██████████	1055	740	740	325	415
██████████	950	740	740	190	550

The variation in doses reflects the location of the personnel during the operation. ██████████, ██████████, ██████████ and ██████████ each approached directly to the shield to operate the latch which held the pump suspended in the shield or to connect and disconnect the drip pan. In the 7-1/2 minutes in which the pump was outside the cell and before it was lowered into the storage pool, ██████████ was in an average field of 20 R/hr.

The dose rate at the surface of the pump was measured under water after the transfer operation and found to be 23,000 R/hr at the hottest location adjacent to the pump head. This level compares with a reading 6000 R/hr for the hottest piece of equipment which had been removed from the cell previously. That equipment, a multiple hydroclone unit, somewhat smaller on overall dimensions than the feed pump, was moved in a 4" thick lead shield. The hottest item removed previously in the large shield used for the feed pump transfer was a fuel circulating pump which read about 1500 R/hr. Exposures in that operation had been low. A significant difference in these operations was the type of activity present in the system. The circulating pump was moved after 70 days cooling when the primary gamma emitter is Zr-95 while the hard gammas from Ia-140 were the predominant source after only 1 week cooling prior to the present operation.

4.0 FACTORS CONTRIBUTING TO THE EXPOSURES

The primary factor contributing to the personnel exposures was the lack of knowledge of the activity level of the feed pump prior to removal from the primary shield. The operation as planned could have been carried out with nominal exposures if the activity level had been in the same order as in previous similar operations. The reactor had been in operation only a short time at low power levels, and the contribution from short-lived gamma emitters was not adequately assessed. In fact, no estimates, except speculative guesses and the high-level monitron reading of the activity level at 10 feet, had been made.

A second factor contributing to the exposures was the lack of the usual plan of action in anticipation of the much higher activity level. In retrospect, a simpler solution than a plan of action would have been a direct reading of the pump activity level in place followed by adequate planning for the transfer operation at the level measured.

A third factor was the lack of experience in monitoring this type operation. Nearly all previous hot equipment removals were made with the cell flooded so that cell background did not contribute to personnel exposure nor interfere with adequate monitoring of the piece of equipment being removed. Readings taken well away from the shield out of the cell beams would have been more indicative of the exposures that personnel were receiving.

The difficulty in communication during the operation due to noise from the alarms actuated by the activity and the fact that all men wore masks, was noted by most of the personnel involved. Again, this problem should have been considered and if necessary, all personnel could have left the area for consultation before proceeding.

5.0 RECOMMENDATIONS

1. Whenever possible, the activity level of hot equipment should be measured prior to movement. For this operation, the measurement could have easily been made.
2. Doses expected from the activity level measured should be estimated. If measurements are not possible, activity levels, a factor of 10 above those anticipated, should be assumed for dose calculations.
3. Adequate emergency plans should be made known to all personnel involved in anticipation of higher-than-expected activity levels, and/or unexpected operational difficulties. This should include plans to regroup and assess the situation at a point away from the hot equipment if radiation fields become higher than anticipated.
4. Adequate communication should be assured either by a suitable sign system, PA system or otherwise.
5. A second health physics surveyor should work directly with the maintenance supervisor in assessing the overall situation during the actual operation. These two should not be involved directly in the operation, and must be able to communicate with each other and with others involved.

The following recommendations fall more in the category of how to do the specific operation involved knowing the radiation levels are as high as they were found to be. It is recognized by all that the plans were based on a factor of 10 lower activity levels and that considerable improvement in equipment and techniques would have been required to significantly reduce the total doses received.

12/15/60

1. Prepare a shielded control station where the crane operator, supervisor and others could retreat to while not performing actual operations.
2. Modify existing lead shield to increase thickness on the side shielding most of the personnel. The total shielding is limited by the capacity of the building crane.
3. Provide better viewing from above the shield so maintenance personnel could observe the equipment removal from a distance. This might be by large mirrors mounted on the crane bridge, or possibly with television cameras.
4. Provisions for disengaging the crane hook, tying off the pump lifting hook and reversing the operations at the hot storage pool should be by semi-remote methods from a distance of at least 10 feet, instead of by hand.
5. If exposures greater than 1 week's dose are anticipated, the previous exposure records of craftsmen available should be reviewed to permit use of people with low previous exposures.

7500 Area Hazards Committee

J. R. Buchanan, Chairman
N. C. Bradley, L. S. S.
W. D. Burch

:psw

Appendix Attached

APPENDIX

REMOVAL OF FFP E. HEAD WITH DRY MAINTENANCE SHIELD

1. HP man on top of cell. Air monitor at work area. Work order signed by shift supervisor.
2. Set up shield "I" beam base.
3. Set carrier down on base to make sure of fit and to see that "I" beams do not twist under the load of the carrier. Open slide to see that it clears the carrier.
4. Lift carrier up and set aside. The hinged "L" tie off assembly should be on top of the shield and in the open position. The drip pan should be located just east of the dry maintenance shield.
5. Attach building crane to the special lifting rod. Make sure all couplings are securely made up.
6. Remove the split plug and light assembly from the ECC. Plug in the maintenance shield and lower hook down thru the shield.
7. Move the shield slide and building crane together to engage the hook into the pump lifting bail.
8. Close leak detector valves of suction discharge and drive flanges and loosen bolts from the control room side.
9. Wet down the pump with a condensate spray.
10. Take up on building crane and move south very slowly with the crane and dry maintenance shield slide.
11. Observe thru the Pb glass window and move pump to the center of the dry maintenance shield.
12. Raise pump up until the (2) half pipe couplings clear the top of the slide.
13. Make sure that pump is positioned in a N.S. direction and lined up under roof plug opening. It may be necessary to lower a hand hook down to straighten it. Should be able to do this by twisting the lifting hook from above.
14. Screw in the (2) 5" pieces of 1" pipe and lower crane hook.
15. Remove the top 15' of lifting handle and screw the lifting bail onto the shortened pump lifting handle.

16. Remove the nuts and pin that join the ECC module and the module north of it. Remove all modules on the north end that are not required for shielding. Clamp a "C" clamp on N. rail approximately 2'-0" from module as a stop.
17. Position the lead carrier over the N.S. and E.W. centerline's of the dry maintenance shield.
18. Set stepladder beside shield in a position to close the tie-off "L" on top of carrier.
19. Move shield slide S. 2'-0" and pull the N. modules by a hand line until the modules are against the "C" clamp on the rail. Lower a drop light thru the top of the carrier and observe the pump with the mirror.
20. Raise pump up slowly thru the lower plug opening and up into the carrier. Monitor carrier.
21. When the 1/2" x 2" x 2" pad on the lifting rod is above the top of the carrier, close the "L" tie off clamp around the lifting rod and lower the crane to let the pad rest on "L" tie off assembly and drop the pin into the end of the assembly.
22. Release the crane hook from the pump lifting bail and hook it to the carrier lifting yoke.
23. Raise carrier up and east and set it down in the drip pan. Attach drip pan to the carrier.
24. Move assembly east and set down just west of pool and remove the drip pan. Position the carrier on the "I" beam frame over the hot cutting tank.
25. Release crane hook from carrier yoke and hook it to the pump lifting rod. Lift up about 2" and remove pin and open the "L" tie off bracket.
26. Lower the pump into the hot cutting tank.
27. Remove all plastic and load drip pan on hot truck.
28. The drip pan may be quite hot and plastic around pool and at east side of maintenance shield may have drippings from the pump on them. HANDLE WITH CAUTION.

Submitted	<u>/s/</u>
	J. P. Jarvis
Approved	<u>/s/</u>
	J. W. Hill
Approved	<u>/s/</u>
	S. E. Beall

Approved	<u>W. T. Martin</u>
Reviewed	<u>/s/</u>
W/Crafts	H. E. Trotter

21. 0-
Rad. Exp.
accidents
Rec. in files 17500
12-12-60

INTRA-LABORATORY CORRESPONDENCE
OAK RIDGE NATIONAL LABORATORY

To: G. C. Cain








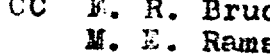

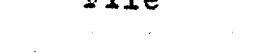

Subject: Radiation Over Exposures at Building 7500

During the removal of the east head of the fuel feed pump from the reactor cell to the hot storage pool cutting tank, ten people received over exposures.

The pump head was withdrawn from the cell into a one inch thick lead shield for transporting across the cell to the cutting tank. The shielded pump read 100R/hr at 6 inches.

Radiation readings of the pump after it was placed in the cutting tank were from 7,200 R/hr to 23,400 R/hr at contact. There was no air contamination during the operation.

Following is a list of the employees involved with film readings:

	Dm	D1	Ep
	2050	1800	1800
	3350	2900	2900
	3050	2600	2600
	1350	1050	1050
	2600	2100	2100
	750	700	700
	1050	800	800
	1150	800	800
	1550	1300	1300
	1450	850	850

CC F. R. Bruce
M. E. Ramsey
A. F. Rupp
File

N. C. Bradley

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to the public by:

David R. Hamlin 12/15/95
Technical Information Officer Date
ORNL Site

CR *H.P. - July*
Rad. Exp. -
Accident
(3025)

OAK RIDGE NATIONAL LABORATORY

OPERATED BY

UNION CARBIDE NUCLEAR COMPANY



POST OFFICE BOX X
OAK RIDGE, TENNESSEE

August 3, 1960

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Dr. H. M. Roth

Gentlemen:

Subject: SOLID STATE INCIDENT - [REDACTED]

On the basis of all available data, it is estimated that [REDACTED] received no more than 1% of the maximum permissible quarterly radiation dose as a result of the subject incident.

During the time of the release, he was working one floor below the hot cell area and left the building by way of the stairs past the hot cells, either during or immediately after the release, and could have been exposed while making his exit from the building. He went directly to the ORNL cafeteria before personnel contamination check points were established at the scene of the release. Upon his return from the cafeteria he was informed of the release and was checked for contamination. A small amount of contamination was found on his clothing and was removed by using a vacuum cleaner until no activity could be detected. In response to a general request for all Building 3025 personnel to collect urine and fecal samples, [REDACTED] submitted the first excreta sample six days after the incident. This sample was collected over the period between day 4 and day 5 after the release, and it indicated a urinary excretion rate of 1,300 d/m per day of radiostrontium (96% Sr^{89} and 4% Sr^{90}). This value exceeds our established urine limit, below which no immediate resampling is required. This limit is 330 d/m per day for Sr^{89} (170 d/m per day Sr^{90}) for chronic exposure; thus additional urine samples were requested. These samples, obtained on day 14 and day 40, indicated total radiostrontium excretion rates of 250 d/m per day and ~ 0 d/m per day (± 20), respectively.

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to the public by:

David R. Hamlin
Technical Information Officer
ORNL, Bldg. 5000

12/15/75
Date

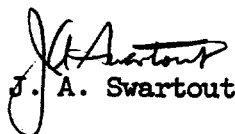
August 3, 1960

The excretion rate data for [REDACTED] was compared with the comparable Sr^{89} , Sr^{90} excretion rates determined for Employee B (see attached plot of excretion rate vs. time). It is seen that Employee B's excretion rate is consistently a factor of 20 higher than that of [REDACTED]. On the basis of many urine and fecal samples, it was estimated that the total initial amount of strontium received by Employee B was $0.60 \mu\text{c}$ ($0.5 \mu\text{c}$ Sr^{89} and $0.02 \mu\text{c}$ Sr^{90}). By comparison of the excretion rates it is seen that [REDACTED] probably received no more than $0.03 \mu\text{c}$ total Sr^{89} , Sr^{90} . This amount is negligible with respect to the maximum permissible body burden for continuous exposure ($2 \mu\text{c}$ for Sr^{90} and $4 \mu\text{c}$ for Sr^{89}) and is even less significant with reference to the maximum permissible bone dose which is proportional to the area ($\int_0^t c Q(t) dt$) under the bone burden curve.

Other radionuclides were present in the mixture of materials inhaled by individuals exposed during the subject release - Ce^{141} , Ce^{144} - Pr^{144} , Zr^{95} - Nb^{95} , Ba^{140} - La^{140} , Cs^{137} . All of these were detectable in the air sample collected during the release and were also detected, by means of a total body counter, in the lungs of the three employees receiving the highest exposures. Repeated total body counter measurements and urine and fecal data were used to obtain estimates of the radiation dose to the lungs and other body organs of these three men. The highest estimated dose was 1.18 rem to the lung of Employee A during the first quarter following the exposure (2.09 rem during the first year). The corresponding estimate for Employee B is 0.30 rem during the first quarter and 0.53 rem the first year. By comparison with Employee B, it is estimated that [REDACTED] received no more than 0.02 rem to the critical organ (the lung) during the first quarter and will receive a total of less than 0.03 rem the first year. These dose estimates may be compared to the maximum permissible dose to the lung, 3.75 rem per quarter or 15 rem per year.

We are convinced that the exposure of [REDACTED] is negligible.

Sincerely yours,


J. A. Swartout

JAS:KZM:mb

Enclosure

cc: C. E. Center
F. R. Bruce
W. H. Jordan
K. Z. Morgan (2)

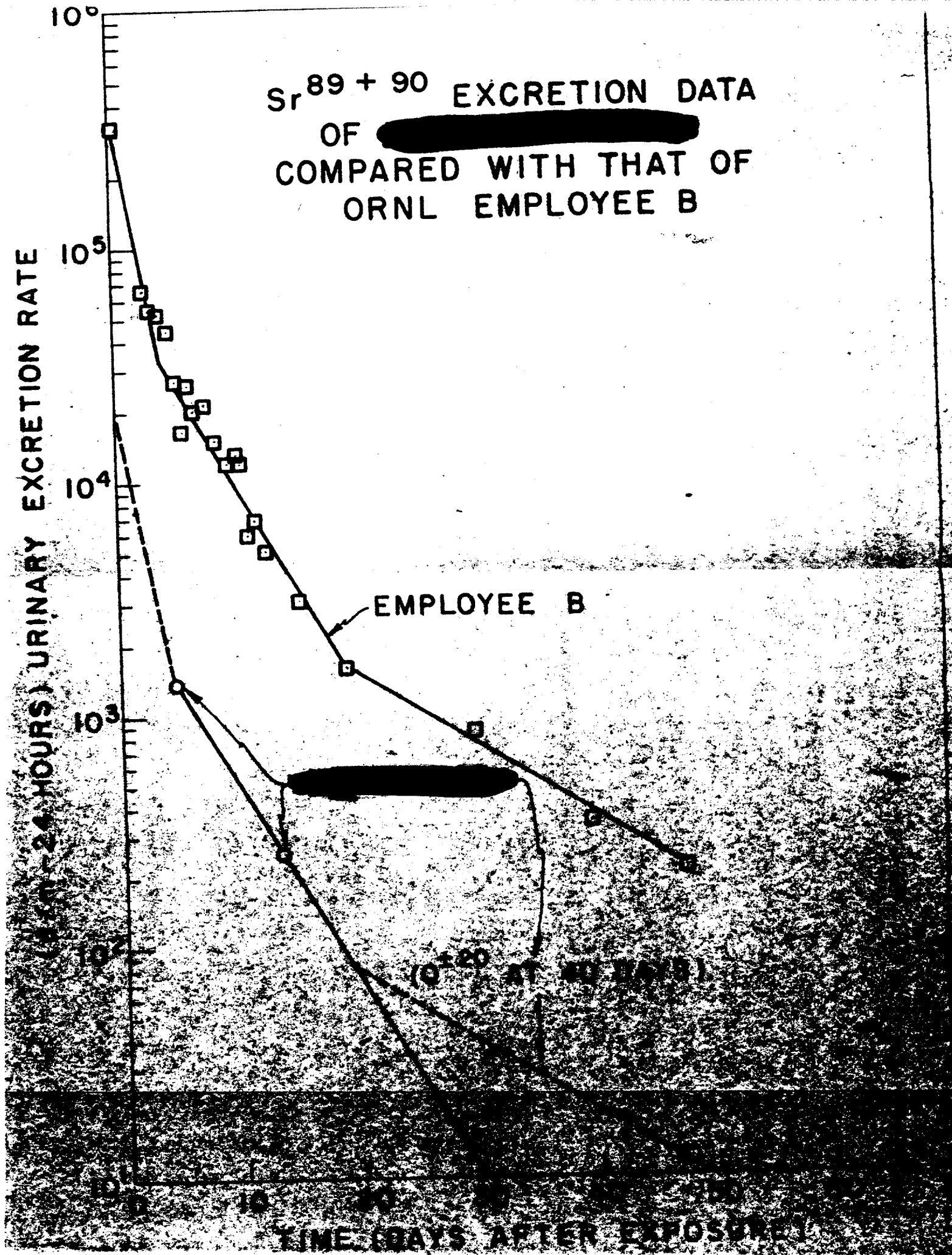
Sr^{89+90} EXCRETION DATA
OF [REDACTED]
COMPARED WITH THAT OF
ORNL EMPLOYEE B

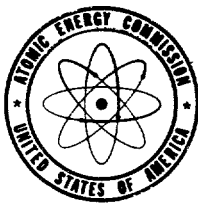
(24 HOURS) URINARY EXCRETION RATE

EMPLOYEE B

(0.20 AT 20 DAYS)

TIME (DAYS) AFTER EXPOSURE





IN REPLY REFER TO:
ORB:JAL

UNITED STATES
ATOMIC ENERGY COMMISSION

Copies forwarded 7-8-60:
F. R. Bruce - Please Handle

Oak Ridge, Tennessee
July 7, 1960

*H.P. -
Lab. Exp. -
CR - Accident
(3025)*

Union Carbide Nuclear Company
Post Office Box P
Oak Ridge, Tennessee

Attention: Dr. J. A. Swartout, Deputy Director *for Mr.*
Oak Ridge National Laboratory

Subject: SOLID STATES INCIDENT - [REDACTED]

Gentlemen:

Confirming informal conversations between members of our respective staffs, we have received an inquiry from the Savannah River Operations Office regarding the degree of involvement of [REDACTED] in the April 26 incident in the Solid States Building.

Specifically, SROO has requested a report or evaluation of the incident, including results of bio-assays or other tests performed on [REDACTED]. An estimate of the nature and severity of his exposure, its probable effect on his future assignments, and any other comments for the employee's record are also requested.

Your cooperation in supplying this information to us at an early date will be appreciated.

Very truly yours,

Herman M. Roth

Herman M. Roth
Director
Research and Development Division

CC: C. E. Center, UCNC
R. C. Armstrong

3025

*RECEIVED
JUL 10 1960
U.S. ATOMIC ENERGY COMMISSION*

ORR:JAL

Oak Ridge, Tennessee
July 27, 1960

VICE PRESIDENT
UCNC

Union Carbide Nuclear Company
Post Office Box P
Oak Ridge, Tennessee

Attention: Mr. C. E. Center, Vice President

Subject: IMPLEMENTATION OF INVESTIGATION COMMITTEE REPORTS

Gentlemen:

Reference is made to your letters dated May 17, 1960, and June 24, 1960, which forwarded respectively the investigation reports for the Solid States Incident and the F3P incident.

We have concurred in the conclusions and recommendations of the referenced reports and have forwarded the reports to AEC Headquarters.

It is requested that UCNC prepare quarterly progress reports regarding the implementation of the recommendations contained in each of the referenced investigation reports. The first progress reports should be prepared as of September 1, 1960, and should continue quarterly until the recommendations have been fully implemented or disposed of in some other fashion.

Your cooperation in this matter will be appreciated.

Very truly yours,

S. R. Sapieha
S. R. Sapieha
Manager
Oak Ridge Operations

CC: R. C. Armstrong
H. M. Roth

This document has been approved for release
to the public by:

David R. Hamner
Technical Information Officer
ORNL-245

INTERNAL CORRESPONDENCE

UNION CARBIDE NUCLEAR COMPANY

C. E. Winters
SAC,
X-10

Date May 23, 1960

Originating Dept.

Answering letter date

F. E. Bruce
Hot Cells and Sources
Committee

Subject Investigating Committee's Report
of the Solid State Physics Con-
tamination Incident.

I have just received a copy of a letter from Union Carbide Nuclear Company to the U. S. Atomic Energy Commission, dated May 17, 1960, enclosing the report identified above. I note that the letter indicates the following action was taken following the incident:

"All hot cells were examined by the Laboratory's Hot Cells and Sources Committee for conformance to the safe operating criteria for hot cells which is presented in Appendix A of the attached report."

If this statement is intended to refer to our Hot Cells and Sources Committee, it needs a slight modification in order to be strictly true. There are two respects in which modification is required:

- a. Since the committee has not completed its examinations of all hot cells, it would be better to say, "All hot cells are being examined...."
- b. The suggested safe operating criteria for hot cells presented as Appendix A of the subject report had not been brought to the attention of our committee, as far as I am aware. Thus, our examinations have not been directed toward establishing conformance to the exact criteria set forth in Appendix A.

Our committee is, as you know, examining the Laboratory hot cells and sources by means of two or more meetings per month and will continue to review facilities at approximately the same rate unless requested to devote additional time to the enterprise. This memorandum was written merely to bring to your attention the possibility that strict interpretation of the May 17 letter of reference could prove embarrassing to the committee.

H. F. McCallie

111

This document has been approved for release
to the public

H. F. McCallie

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

May 23, 1960

To: D. S. Billington

We have told the Commission that approximately eighty people were in Building 3025 at the time of the recent incident. Will you please ask someone to establish the exact number (and names) of those present. I think this information will be important for the record.

Original Signed
By F. R. Bruce
F. R. Bruce

FRB:mb

cc: ✓ J. A. Swartout 4.5.60

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to the public by:

David R. Hammin 12/15/95
Technical Information Officer Date
ORNL 800

UNION CARBIDE NUCLEAR COMPANY .

POST OFFICE BOX P, OAK RIDGE, TENNESSEE

May 17, 1960

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. S. R. Sapirie

Gentlemen:

Subject: Investigating Committee's Report of the Solid State
Physics Contamination Incident

In accordance with the provisions of Chapter 0703 of the AEC Manual, entitled Notification, Investigation and Reporting of Incidents, we are enclosing twenty copies of the report of the Committee established to investigate the radioactive release in the Solid State Physics Building on April 26, 1960.

For your information, the following action was taken promptly following this incident to preclude similar occurrences in this and other hot cell facilities of the Oak Ridge National Laboratory:

- (1) All hot cells were examined by the Laboratory's Hot Cells and Sources Committee for conformance to the safe operating criteria for hot cells which is presented in Appendix A of the attached report.
- (2) All operations involving significant quantities of radiation were required to be carried out in accordance with a safe operating procedure to be approved by the division director and the Director of Radiation Safety and Control.
- (3) A radiation control officer will be assigned in each division. He, under the division director, will assume full responsibility for radiological safety in the division, actively and aggressively keeping under constant surveillance all operations of the division which could lead to radiation incidents.

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David R. Harnish 12/15/95
Technical Information Officer Date
ORNL Size



- 2 -

May 17, 1960

- (4) Every division director has been instructed to carefully re-examine all of his operations for potential radiation safety problems and to work with Laboratory management in promptly correcting them.

Yours very truly,

UNION CARBIDE NUCLEAR COMPANY

A handwritten signature in cursive script, appearing to read 'L B Center'.

Clark E. Center
Vice President

A handwritten mark, possibly initials 'L7', written in ink.

CEC:FRB:mb

Encl.

cc: J. A. Swartout (2)
F. R. Bruce (40)

Report
of
Investigating Committee

BUILDING 3025 INCIDENT
Oak Ridge National Laboratory
April 26, 1960

F. R. Bruce, Chairman
D. E. Ferguson
J. A. Lenhard, ORO
G. W. Parker

Report Submitted:

May 17, 1960

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to the public by:

David R. Hamm 12/15/95
Technical Information Officer Date
ORNL Staff

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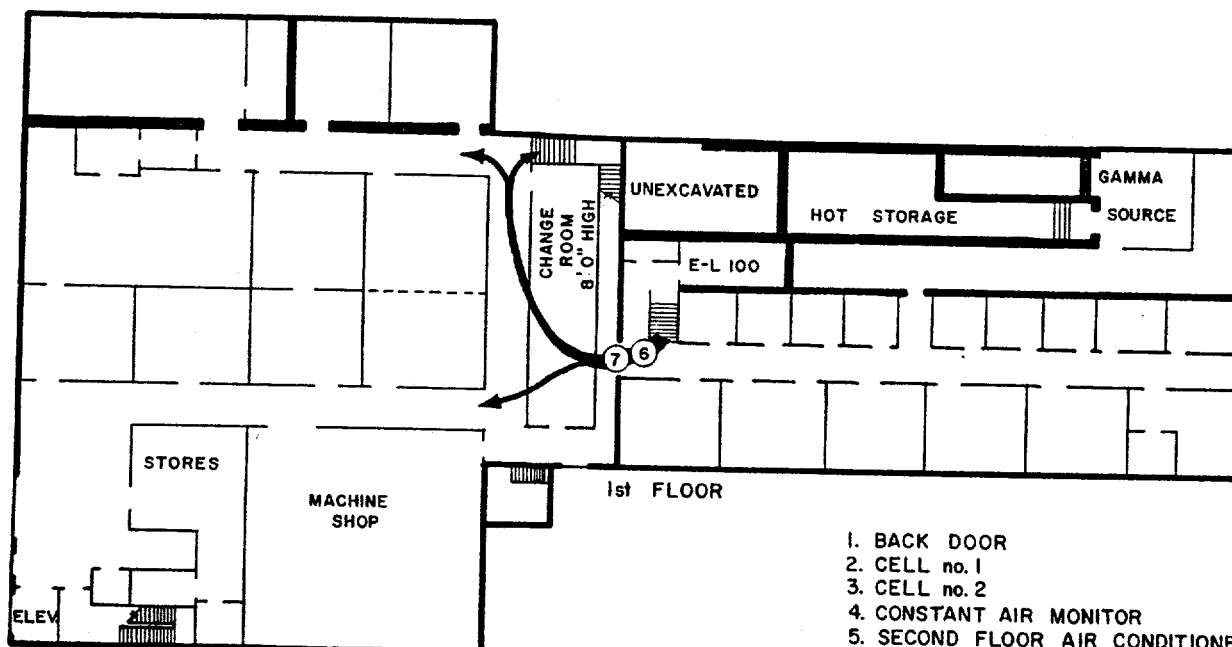
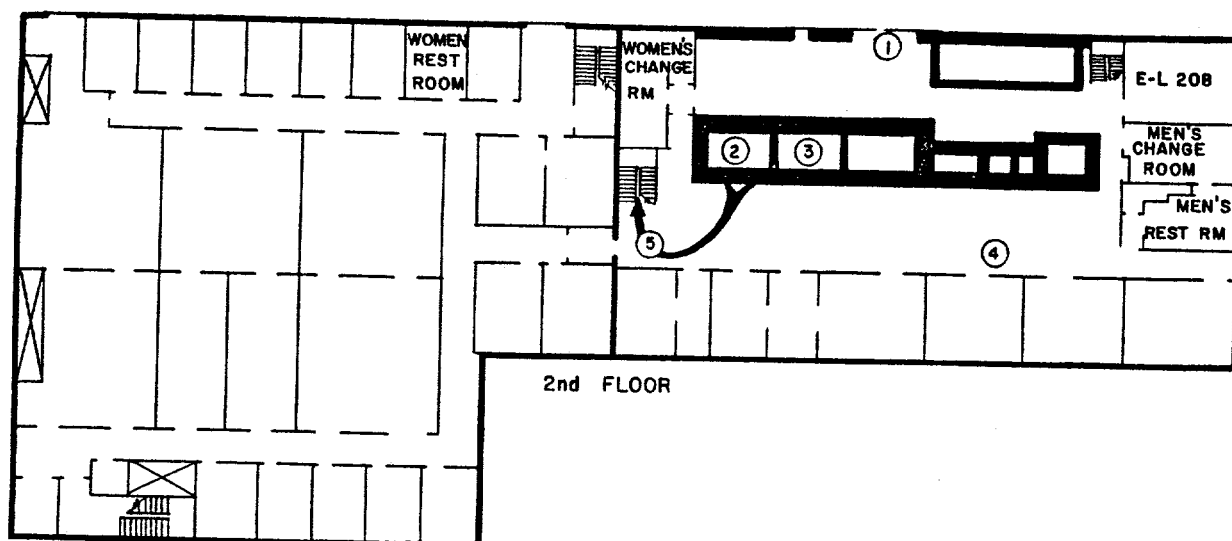
I. Summary

On April 26, at approximately 11:00 a.m., a quantity of beta and gamma active dust, estimated to contain a total of <1 curie of activity, was expelled from Cell 1 in Building 3025. At the time of the release there were 8 persons in front of this cell and directly in the path of the dust cloud. Another 13 persons were in the general hot cell area but not directly in the path of the cloud. None of the exposed individuals is believed to have received in excess of the maximum permissible exposure. Analysis of presently available exposure data, which must still be considered preliminary, indicates one person ingested a quantity of activity which will give a 1.2 REM exposure to both lungs and bone during the first quarter and 2.1 REM during the first year. The next person will receive a 0.3 REM exposure during the first quarter and all others at least a factor of 10 less than the highest exposure. The beta and gamma active dust was distributed throughout the hot cell area and the office-laboratory areas of Building 3025, making it mandatory that extensive decontamination be carried out before any of this building could be used. As of May 12 the estimated cost of cleanup is \$39,500. No significant amount of activity was discharged from the building at ground level and no activity attributable to this incident could be found on the roof of the building where the ventilation system exhausts are located.

The exact mechanism of the expulsion of this activity from the cell is not known. However, there was a combination of conditions which either singularly or in combination could account for the release. Sawing of a contaminated graphite capsule had just been completed, leaving Cell 1 highly contaminated with a readily air-borne radioactive dust. The pressure drop between the operating area and Cell 1 was observed to be only a few hundredths (.02 to .03) of an inch of water earlier in the morning. An air hose was used to blow some of the radioactive dust off a piece of paper just prior to the incident. Openings in the face of Cell 1 were shielded but not sealed. Alterations to the adjoining cell, Cell 2, were in progress, and Cell 2 was open to the operating area, to the back area, and to Cell 1. The large back door to Building 3025 was open. This set of conditions would allow pressure disturbances created in the back area by the wind to be transmitted through Cell 2 into Cell 1 and blow the activity out the unsealed penetrations in the face of that cell into the operating area.

A floor plan of Building 3025 is given in Fig. 1. The main radioactive dust cloud after leaving the face of Cell 1 was sucked down the stairwell just west of the cell. A large fraction of the cloud was picked up by the air conditioners at the head and foot of these stairs. Most of this activity was caught on the intake filters for these air conditioners. The remainder was then distributed back over the hot cell area. The filters on these air conditioners read 3-4 r/hr after the incident.

The alarm was given at about 11:00 a.m. by a constant air monitor located in the hot cell operating area. A Health Physics representative was



1. BACK DOOR
2. CELL no. 1
3. CELL no. 2
4. CONSTANT AIR MONITOR
5. SECOND FLOOR AIR CONDITIONER
6. FIRST FLOOR AIR CONDITIONER
7. CONNECTING DOOR,
(PROPPED OPEN AT TIME OF INCIDENT)

0 10 20 30 40 50

FIG. 1 BUILDING 3025 FLOOR PLAN

called immediately and evacuation of the area was started as soon as the alarm was confirmed. People leaving the building were monitored and appropriate personnel decontamination procedures used. It was not realized, however, until 8:00 p.m. that the activity was air-borne throughout the building. At this time the ventilation system was shut down and appropriate steps taken to contain and remove the contamination.

As of May 12, in the west section of the building, the ventilation system has been cleaned to the point it is delivering clean air; all offices, labs, and halls have been cleaned and found, with a very few exceptions, suitable for reoccupancy. The second floor of the east end, hot cell area, has been cleaned and spot checks indicate it to be habitable. The basement, however, will require about another week of cleaning.

II. Chronology

April 11, 1960

Installation of equipment for the disassembly and inspection of the irradiated fueled graphite specimen was started in Cell 1 by a group under [REDACTED]. This involved a series of operations. The first was to cut off part of the outer stainless steel structure so that the stainless steel container could be punctured. This involved sawing activated stainless steel. No activity was observed outside the cell during this operation. The stainless steel capsule was then punctured and a gas sample obtained. Care was taken to seal most of the cell openings with masking tape during this operation, and again no activity was observed outside the cell. The assembly was then cut down to a shorter length to obtain a gamma scan to determine fission product distribution. A sharp delineation of the fueled graphite sample was obtained on the gamma scan, indicating that little diffusion of fission products had taken place. The fuel samples, in their impermeable graphite capsules, were removed from the stainless steel can. The two graphite capsules were then exposed for the final sawing operation needed to reach the fuel samples.

April 11, 1960

On about the same date as the start of the disassembly experiment, alterations to Cell 2 were started. These alterations involved drilling seven holes throughout the cell face for the installation of manipulators, a stereomicroscope, a periscope, and a window. At the time of the incident these holes were completely open. The roof slab on Cell 2 was also off to give access, and the back door to the cell was ajar. Thus Cell 2 was open to the back area, the front operating area, and to Cell 1, since the cells at best have about 3 square feet of open interconnection.

April 26, 1960

In Cell 1 [REDACTED] group cut off both ends of the impermeable graphite capsule, taking a 1/16 in. cut on each end which just missed the fueled

graphite sample as planned. A vacuum cleaner was used to collect the graphite sawdust and was reported by visual observation to have collected about two thirds of it. The fuel sample was shaken out of the opened capsule and placed on white blotter paper. Some graphite dust was spilled on the paper during this operation and an air hose was used to blow this dust away. This air hose consisted of a plastic tube attached to the 15-lb air supply and was controlled by a needle valve. It was estimated that this hose was used for about 2 min at a flow rate of 0.1 ft³/min. [REDACTED] group then started taking pictures of the fuel specimen. There is no clear correlation of the time of the activity release with these operations. It probably occurred shortly after the dust was blown away with the air hose. Earlier in the morning Cell 2 had been checked by a Health Physics surveyor prior to carpenters entering in connection with the alterations. Just prior to the activity release, [REDACTED] was engaged in passing APPR fuel specimens through Cell 2 to the Cell 2 extension. The specimens were cleaned and polished; however, there was a possibility that the tray contained some radioactive dust. This transfer had just been completed when the activity release was detected by the constant air monitor. However, radiochemical data indicate the activity release was from the Cell 1 operation.

April 26, 1960
11:00 a.m.

The constant air monitor about 50 ft east and across the operating area alarmed. At this time eight persons, [REDACTED], [REDACTED], [REDACTED], [REDACTED], and [REDACTED] were working directly in front of Cell 1. [REDACTED] was in the area back of the cells completing his transfer. [REDACTED] was working in the laboratory adjacent to the constant air monitor. Eleven other persons were in the hot cell area, mostly in the east end away from Cell 1. About 30 seconds after the alarm sounded, [REDACTED] placed a call to the Health Physics office across the street in Building 3001. [REDACTED] took this call and arrived about 11:02 a.m. and checked the air monitor and found it to be operating but not recording since the inkwell was dry. He also ascertained with a portable survey instrument that the filter paper was reading about 10 mr/hr and that the general area in front of Cell 1 was contaminated to the extent of 100 mr/hr with spots reading 300 to 400 mr/hr. At this time, about 11:05 a.m., he recommended to [REDACTED] who had arrived in the hot cell area with [REDACTED] that the cell area be evacuated, and this recommendation was passed on to the group working in front of the cell who evacuated promptly. After setting up a personnel monitoring station at the connecting door to the west end of the building, [REDACTED] returned to Building 3001 to obtain masks. [REDACTED], [REDACTED], [REDACTED], and [REDACTED] remained in the hot cell area to close up Cell 2 which was suspected of being the source of activity at that time. They put paper over the openings in the front of the cell, put the roof plug on the cell, closed the back door to the cell and the back door to the building. During this period [REDACTED] observed that the constant air monitor in the area back of the cells located on top of Cell 6 had not shown a significant increase in activity. Later inspection of this instrument showed that the

activity in this back area began to increase about 11:00 a.m. and increased slowly to about twice its original reading by about 2:00 p.m. but did not reach its alarm point. The persons who remained behind to close up Cell 2 evacuated the hot cell area about 11:15 a.m. and joined the group being monitored at the connecting door between the two ends of the building. During the period up to 11:15 a.m. it had become evident that a few persons who had not been in the hot cell area were also contaminated, and that of those persons in the cell area only those who were directly in front of Cell 1 were significantly contaminated. Those persons who were in front of the cell had activity spread over the upper portion of their bodies, hair, shirt, hands, which was in excess of 20 mr/hr, and it was reported that some of their faces were also reading greater than 20 mr/hr. Immediately upon finding that the persons were contaminated to this level, they were given shoe covers and directed to the change room in the basement of the west end of the building where they took showers and scrubbed up. A second monitoring station was set up at this change room to check the progress of their decontamination. Two employees were still sufficiently contaminated that they were directed to the dispensary where nasal decontamination was effected.

April 26, 1960
About 11:15 a.m.

It was realized that a serious release of contamination had occurred and it was recommended that the entire 3025 Building be evacuated as soon as practical. Additional Health Physics help was requested to monitor the persons leaving the building. Approximately 80 persons were evacuated and monitored before they left the building. Of this number, about 30 were found to be contaminated to an extent that decontamination or change of clothing was required. Only 2 persons with significant contamination on their clothing are known to have left the building. They left about 11:00 a.m. before the extent of the incident was known and went to the cafeteria for lunch, thereby contaminating two chairs and a table in the cafeteria. The building evacuation was completed about 11:30 a.m. and personnel monitoring by about 12:15 p.m. However, personnel decontamination continued until about 2:00 p.m.

April 26, 1960
About 12:15 p.m.

Decontamination of the building was started. At this point it was not realized that the activity was primarily air-borne so that only the floors were scrubbed and vacuumed. This operation was continued until about 8:00 p.m. By this time it became evident that areas which had been successfully cleaned were being recontaminated, and it was realized that contamination was continually being distributed throughout the building by the air conditioning system. At 8:00 p.m. it was clearly realized that the activity was air-borne and that the contaminated air conditioning systems were the source of the recontamination. An inspection of the ventilation system indicated that the

entire ventilation system was contaminated. Filters on the two air conditioners in the hot cell area nearest Cell 1 were reading 3-4 r/hr. The air conditioning filters for the west end of the building were reading 40-60 mr/hr. The building ventilation system was then shut down. The subsequent cleanup is described in a separate section on decontamination.

III. Description of Irradiated Specimens and Hot Cell Operations

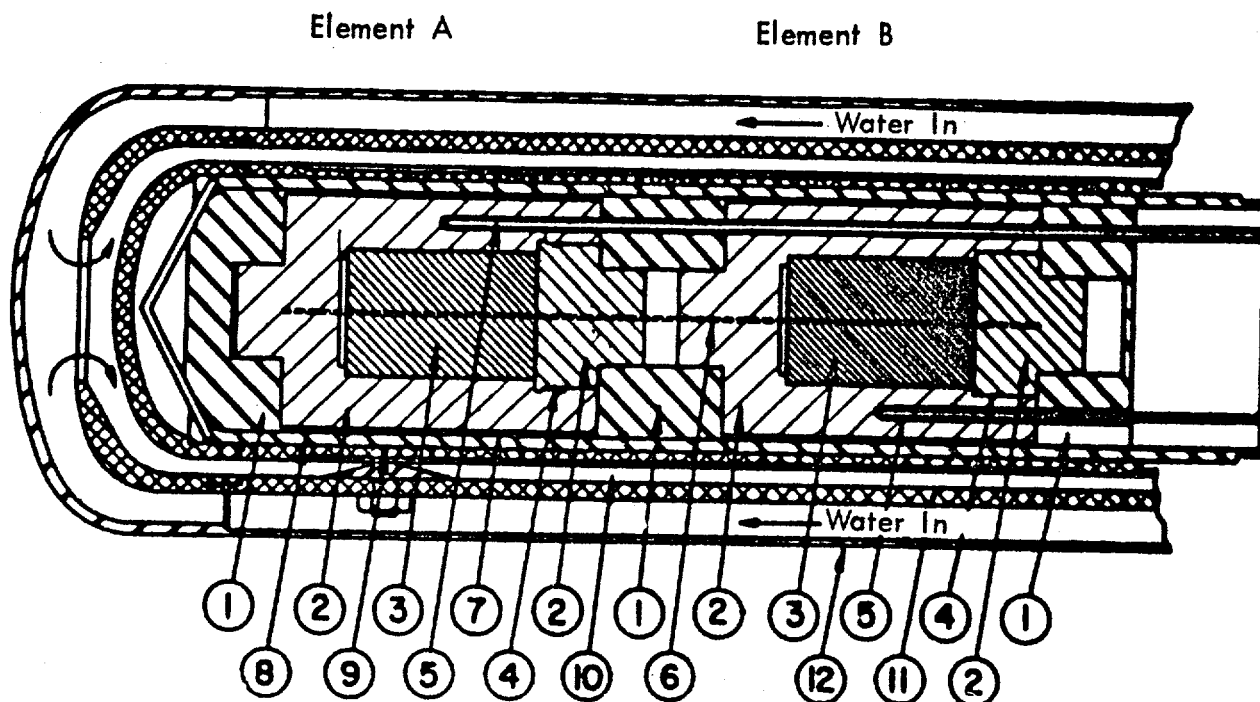
Irradiation data regarding the experiment being examined in Solid State Cell 1 at the time of contamination of Building 3025 is listed below.

ORNL-MTR-48-1 Irradiation Data

	<u>A Element</u>	<u>B Element</u>
Date into reactor	Nov. 2, 1960	Nov. 2, 1960
Date out of reactor	Jan. 25, 1960	Jan. 25, 1960
Time at power, hr	1400	1400
Av. thermal neutron flux, n/cm ² .sec	$\sim 4 \times 10^{13}$	$\sim 3 \times 10^{13}$
Av. temperature in graphite, °F		
end toward reactor	1600	1400
end away from reactor	1100	800
Burnup, % U-235	14	6
Burnup, weight U-235, g	0.44	0.37
Date into hot cell	April 18, 1960	April 18, 1960
Date of contamination incident	April 26, 1960	April 26, 1960
Decay time, days	92	92

Figure 2 is an assembly diagram of the fuel-containing section of the experiment, and Fig. 3 is a diagram of element B, the one which was cut open, showing the positions of the saw cuts.

Examination of this experiment was begun by making a saw cut through the outer containment vessel, item 9, Fig. 2. The mixture of helium fill gas and the fission gases evolved from the fuel was collected by piercing a tube attached to the inner containment vessel, item 8, Fig. 2. Another saw cut through both containment vessels allowed removal of the two fuel capsules, elements A and B. The external dimensions of these graphite containers were measured with micrometers. The fuel cylinder was removed from element B by making saw cuts as indicated. It should be pointed out that the fuel cylinder definitely was not cut, since (1) the small shoulder of the graphite container was left intact at one end, and (2) a thin disk



1. Porous carbon 60.
2. R-0020 type graphite.
3. U-235 fueled-graphite-matrix cylinders.
4. Graphite threads sealed with Si-SiC.
5. 316 stainless steel sheathed MgO insulated Cr-Al thermocouples (3) 120° apart per cylinder.
6. Flux monitor wires (3) 120° apart, full length of both fueled-graphite cylinders.
7. Helium gas gap - 0.010 inch.
8. Inner containment vessel - stainless steel 304.
9. Outer containment vessel - 6061 aluminum (with longitudinal grooves).
10. 1/8-inch water flow annulus.
11. Water flow divider - 6061 aluminum.
12. Outer water jacket - 304L stainless steel.

Fig. 2. Diagram of assembly for ORNL-MTR-48 in-pile capsule irradiation test.

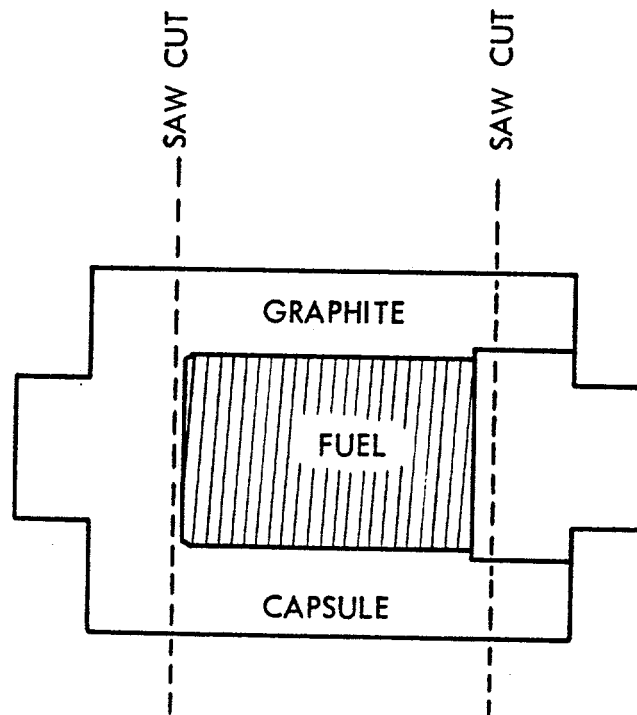


Fig. 3. Element B.

was cut off the end plug at the other end. The fuel cylinder was examined through the periscope and placed on clean white paper in preparation for photography.

IV. Radioactivities Involved in the Incident

The spectral distribution of radioisotopes involved in this incident was unique and no obvious explanation for the observed isotopic distribution has arisen. The activities found generally exhibited the following ratios.

<u>Isotopes</u>	<u>γ Ratios</u>	<u>β Ratios</u>
Gross γ	1	
Ce (141 + 144)	0.9	
Zr-Nb-95	.03	
Co-60	.006	
La-140	.005	
Gross β		1
Ce β (141 + 144)		.55
Trivalent R.E. (primarily Y-91)		.26
Sr β		.15

The ratio of Sr-89 activity to Sr-90 activity was ≥ 10 and the ratio of Ce-144 to Ce-141 activity was 1.3, both ratios being what would be expected from the irradiation and cooling history of the samples.

Since the fuel specimen itself was not cut, but only the graphite capsule, it was expected that those fission products which are volatile or have volatile precursors under the conditions of the experiment (2500°F in a graphite system) should be present in this material. In the case of Ce-144 this did not hold. Ce-144 has no volatile precursor with a significant half life. One might conclude that only activities which are not volatile are involved and that the volatile materials have migrated elsewhere. The small amount of Zr-Nb-95 gamma found contradicts this assumption since these would not be volatile and have no volatile precursors under these conditions. These apparent anomalies can only be resolved by further investigation.

The activity found in the two constant air monitors, in the analysis of fecal samples from the exposed personnel, in smears taken of the general area, in smears taken from the Cell 1 openings, all qualitatively fall into

the above pattern of radioisotope distribution. The discrepancies that exist are minor and can be explained easily by the methods used to prepare the samples for analysis or by the previous history of the samples.

The roof of Building 3025 was found generally contaminated to about 5 mr/hr and in many spots to >20 mr/hr. Samples from this area contained only Ru-106 activity. Therefore, it was concluded that the roof contamination is primarily due to the stack discharge of last year.

V. Personnel Dosimetry

External Dose. The film badges for the 8 men who were most heavily contaminated were processed a few days following the release as a matter of precaution. The highest exposure among these was 120 mr of penetrating radiation, which represented the employee's total external exposure since April 1, 1960, when the film badges had last been changed.

Internal Dose. It is not usually possible to make accurate internal dose estimates within a few weeks following an exposure, particularly when there is a mixture of isotopes and more than one critical organ must be considered. The following information is based upon incomplete data and certain simplifying assumptions with regard to the metabolism of the isotopes involved.

Bioassay samples were taken from all persons who were in the building at the time of the release. Initially, the analysis of these samples was limited to the 8 most heavily contaminated persons. As of May 16, samples from 25 of the other persons in the building have been analyzed and none has shown activity in excess of the lowest of the 8 present at the cell face. Whole body counter measurements and additional urinalysis were performed on 7 employees. (The eighth is an employee of the National Carbon Company. Arrangements are made for obtaining body counter and additional bioassay data for this man.)

Available body counting data indicate that the material is localized in the lungs, and both urinalysis and body counting data indicate that the material is being eliminated from the lungs at an unusually high rate. At 10 days following the exposure, about 75% of the original lung burden of 2.4 microcuries of strontium had been eliminated from the lungs in the case of employee "A" below. Solubility measurements of typical contamination samples in blood serum have been made and tend to confirm the high rate of removal of the activity from the lungs. Following are estimates of the dose to the lungs and bone of the 8 employees. The dose to the lungs assumes that all material in the lungs as of 10 days following the incident is removed only by radioactive decay. The dose to the bone assumes that about one-half of both the cerium and the strontium due to leave the lungs by way of the bloodstream is deposited in the bone.

Current Estimates of Internal Dose*
(Preliminary)

Employee	Lung		Bone	
	1st Quarter REM	1st Year REM	1st Quarter REM	1st Year REM
A	1.18	2.09	1.14	2.24
B	0.30	0.53	0.29	0.56
C	0.11	0.19	0.10	0.20
D	< 0.10	0.17	< 0.10	0.19
E**	< 0.10	0.16	< 0.10	0.17
F	< 0.10	< 0.10	< 0.10	0.10
G	< 0.10	< 0.10	< 0.10	< 0.10
H	< 0.10	< 0.10	< 0.10	< 0.10

* Greater than 90% of the dose estimated for the lungs and the bone will be from the strontium isotopes.

** National Carbon employee--dose estimated on the basis of a single urine and fecal sample.

Studies will continue in order that these exposures can be estimated with more certainty.

VI. Decontamination of Building 3025

When it was realized at 8:00 p.m. on April 26 that the building was being contaminated with air-borne activity, the air conditioning system was shut off, both interconnecting doors between the old portion and the new portion of the building were sealed, and air monitors were set up. Additional janitorial help was enlisted and a 24-hour work schedule was initiated. The east end of the old portion was only slightly contaminated, and the cell change room was usable after a plastic shield was set up at the end of the entrance hall at the east end of the second floor. A change room was also set up at the southwest corner of the new portion of the building.

Cleaning of the ventilation system began with removal of the contaminated filters. Next the supply and exhaust diffusers were cleaned by vacuuming and washing with detergent. Ducts were vacuumed as far back as could be reached with extension hoses. In some cases where activity was detected and could not be reached, an entry port was cut in the duct to permit access for cleaning. When cleaning of the ventilation system was completed, two layers of American Air Filter Air Mat, Type G, filter paper were installed behind each supply fixture.

After the air handling system was cleaned it was turned on and allowed to run for about 12 hours. Air samples taken during this period showed that the air supplied to the building uniformly contained about 10^{-11} - 10^{-12} $\mu\text{c}/\text{cc}$, well below tolerance for the radioisotopes involved. However, the air flow had been reduced to 60% of normal by the filters over the supply fixtures. The decision was then made to move both layers of the room supply filters, autoradiograph them, and replace them with a single layer of American Air Filter Air Mat, Type G. The autoradiographs showed that very little radioactivity was present in the circulating air in the new portion of the building. Again the system was turned on, the air sampling repeated, and the system was found to be delivering clean air.

Work was then continued on cleaning the labs and offices. Contamination was located by means of a probe and the area marked. Since the contamination was particulate in nature, practically all of it was very effectively removed by vacuuming. If the radioactivity was not removed by vacuuming, scrubbing with a detergent was employed. In the few cases which required more strenuous treatment, the area was sprayed with paint of a distinctive color and special decontamination techniques such as removal of paint and tile were used. After cleaning, a very thorough probing was given all areas. Before occupancy, final checking by smearing was carried out.

As of May 12, seventeen days after the release of active material, the air system of the new portion of Building 3025 has been monitored and found to deliver clean air. The offices, labs, and halls have been probed, smeared, and with but few exceptions found to be within tolerance for use. The exceptions are expected to be cleaned by May 16, 1960.

In the old portion of the building, the cell operating area has been cleaned but only a spot check made for residual activity. The first floor in the old portion of the building is more contaminated and will require additional decontamination time.

VII. Conclusions

1. In retrospect, the Committee feels that the primary cause of this incident was that a reactor fuel capsule of an advanced type and completely new to the persons involved was being handled with procedures and equipment which were inadequate to cope with the unusual hazard involved.
2. Under the existing conditions, the incident was capably handled by all persons and groups involved. However, the following conditions could have contributed to making the accident much more serious than it was.
 - (a) Inadequate radiation monitoring equipment was available to determine the extent and nature of the activity released. Not until 8:00 p.m., 9 hours later, was it clearly realized that the continued spread of activity was implemented by the air conditioning system. (An additional air monitor for installation in the west end of Building 3025 had been requested on August 20, 1957, but approval was not obtained.)
 - (b) No emergency communication system was available, and at least 15 minutes were required to alert the building occupants that a radiation release had occurred.
 - (c) No masks or other emergency supplies were readily available; and after they were aware that air-borne activity was present, five persons remained in the area without masks to secure the cells.
 - (d) While urine samples were taken from all persons involved in the incident, most were not analyzed up to May 8, 12 days after the incident.
3. The sawing of a heavily contaminated graphite capsule in Cell 1 was an unusually hazardous operation, since a radioactive dust, easily suspended in air, was created. Prior to the incident no one properly assessed the extent of this hazard.
4. The facility, in addition to not being equipped for such an operation, was in a dangerous state. For instance, the off-gas filters were bad, the adjoining cell was wide open, the cell pressure was dangerously near that of the operating area, and the back door to the building was left open.
5. The flow and recirculation of air throughout the entire building, from hot cell areas to office-laboratory areas, was contrary to good practice, and previous incidents somewhat similar to this one but of lesser extent were common knowledge of persons familiar with this area.

6. The persons carrying out the experiment, in view of the unusual hazard involved, were not sufficiently aware of Health Physics fundamentals, safety, and the limitations of the facility in which they were working.
7. Established procedures in the Solid State Division for insuring safe operation in this area were not employed, and as a result no outside help, such as Health Physics, was called in for evaluation of hazards. No specific consideration of hazards was included in the experiment description prepared for hot cell work.

VIII. Recommendations

1. A comprehensive set of criteria for safe operation in hot cells for Oak Ridge National Laboratory (an outline of our suggested minimum containment standards is given in attachment A) should be established, and all hot cell operations at the laboratory should be reviewed to determine whether they meet such minimum standards.
2. Until hot cell facilities at Oak Ridge National Laboratory are made to meet the minimum containment standards, each experiment which could conceivably result in unusual personnel exposure or ingestion, in an unusual contamination problem, in operational interruption, or an incident of public relations significance should be subjected to extra-Divisional review.
3. In addition to establishing criteria for safe hot cell operation at Oak Ridge National Laboratory, management should establish a mechanism for insuring compliance with these criteria.
4. Emergency procedures and a trained emergency organization with proper emergency equipment should be established for all hazardous areas.
5. A general educational program in radiation safety and control should be established for personnel at Oak Ridge National Laboratory working with radioactive materials.

Submitted:

F. R. Bruce
F. R. Bruce, Chairman

D. E. Ferguson
D. E. Ferguson

J. A. Lenhard
J. A. Lenhard

G. W. Parker
G. W. Parker

Attachment A

Outline of Minimum Standards for Hot Cells

1. A minimum of 0.1 in. of water vacuum must be maintained on hot cells and a minimum flow through any opening of at least 100 ft/min with sufficient exhaust capacity that these minimum values can be maintained for any creditable situation that may arise, and an alarm provided to indicate when the vacuum drops below 0.1 in. of water.
2. Exhaust from hot cells must pass through at least one roughing filter and an absolute filter and be continuously monitored with an alarm before being discharged to the environment.
3. For any operation which is likely to produce gross amounts of air-borne contamination, an additional line of containment within the cells should be provided with an exhaust which is filtered before discharging into the cell ventilation or other suitably filtered system.
4. Provision must be made for removing chemical contamination from the cell offgas such that the filters are not impaired and special, chemical resistant filters used where needed.
5. Vacuum lines run into cells should be adequately trapped, treated for chemical contamination, and filtered before leaving the shielded area.
6. All known liquid radioactive effluents should be routed to the appropriate hot waste system.
7. All other possible routes of radioactive material release, such as process water drains within the cells should be monitored and provision made for diversion to the hot waste system made. Process water should not be discharged to the hot waste system except in case of an emergency.
8. All operations in hot cells which involve unusual hazards, such as, large quantities of alpha or soft beta activity which are difficult to detect; gaseous activity; possibility of an uncontrolled chemical reaction, fire, or explosion; and possibility of a critical assembly should be individually reviewed by the director of Radiation Safety and Control.
9. The area around hot cells up to a second line of contamination control should be regarded as a likely contamination zone, and monitoring for all persons and materials leaving this clearly defined zone should be mandatory.

10. Adequate radiation detection instruments should be present in such areas to give prompt indication of air-borne activity, any significant spread of contamination, or an increase in background activity.
11. In addition to a line of contamination control, provision for a complete second line of containment should be provided around hot cell areas, such that, when a radiation release is detected, the area is automatically isolated and exhausted through a filter, if practical the cell ventilation system.

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

May 16, 1960

To : A. M. Weinberg
Building 4500

From: K. Z. Morgan
Building 2001

cc : B. R. Fish

Enclosed is a copy of a preliminary report from Mr. Fish
which I believe will be of interest to you.

K. Z. Morgan
K. Z. Morgan

Enclosure

KZM:ss

This document has been approved for release
to the public by:

David R. Hamlin 12/15/95
Technical Information Officer Date
ORNL Site

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

cc: Don E. Ferguson
W. H. Jordan
J. C. Hart
E. G. Struxness
Section Chiefs

May 12, 1960

To: K. Z. Morgan

From: Mircea R. Fisa

Subject: Current estimate of internal dose for eight persons exposed during the contamination incident in building 5X25, April 20, 1960.

You are well aware of the difficulty encountered in estimating internal doses to mixed radioisotopes so I will not belabor the point except to emphasize that the estimates presented in this memo are based upon incomplete data and certain simplifying assumptions which, of course, will be reviewed as better information becomes available. We are continuing to study the problem and you can expect some modifications to be made in the present set of estimates.

In addition to the fact that there was a mixture of isotopes, the exposure material was contained in or on particles of graphite. The presence of the graphite in the lung could influence the pharmacodynamical clearance mechanisms to such an extent that available data on elimination of the carrier-free isotopes may not apply. It can be seen from the data that the individual exposures are not uniform either in quantity or in the relative proportions of the various radionuclides.

An initial appraisal of the exposures was based upon the first urine samples which were submitted following the incident. These first samples provided an indication of which individuals had the highest exposures, their probable rank order and an estimate of initial strontium intake which still appears to hold within a factor of about 2.

On Friday following the incident, Mr. C. A. West of the Y-12 Health Physics Department rescheduled their own IVRM work in order to make their whole body counter available for checking the ORNL employees who had the highest potential exposures. Mr. E. A. Corfield of the Y-12 Technical Division directed the measurement of the in vivo gamma-ray spectra from the chest region and made several exploratory scans to determine possible deposits of radioactive materials in other portions of the body. Both Mr. West and Mr. Corfield have been exceptionally helpful in making it possible to have selected individuals rechecked in the whole body counter on many occasions in connection with this as well as previous exposure incidents. These rechecks often require that a half day of machine time and countless hours of data reduction be devoted to each man checked.

The second series of exposure estimates was based upon the raw data from the whole body counter, approximate calibration factors and the first estimates of the relative abundance of various radionuclides in air samples taken during the release and which were analyzed radiochemically. An order of magnitude estimate of the radiation dose to the lungs during the first quarter was obtained by

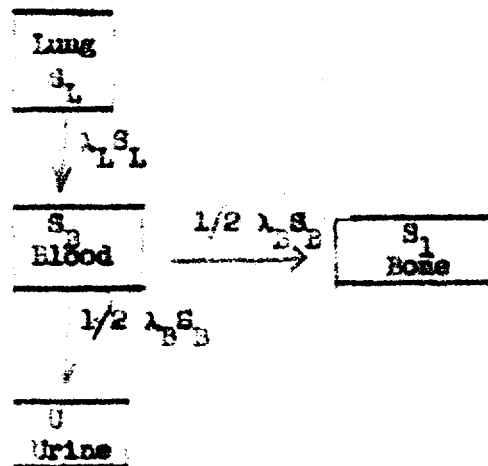
assuming no biological elimination from the lung of the material detected by means of the whole body counter, and, further, assuming that the lung contained an equal number of curies of strontium (which could not be detected), as it did of Cerium (estimates based upon the 145 kev gamma associated with Ce^{141}). Equal amounts of strontium and cerium activities had been found in a few feces samples submitted by some employees. Using these approximations the highest dose was estimated to be 1.94 REM for the first quarter, three others in the range 0.1 to 0.2 REM, and three others in the range 0.03 to 0.09 REM. The eighth man, an employee of National Carbon Company, was not available for a measurement in the whole body counter, however, on the basis of a single urine specimen in relation to the excretion rates of the other men, his exposure to the lung was expected to be on the order of .1 REM for the quarter.

It may be of interest to discuss the current dose estimates by employee in order to emphasize the incompleteness of the data and to point out a few instances in which crosschecks have been possible. The case of the man receiving the highest dose was examined in considerable more detail than that of the other men and will be reported first.

██████████ was checked in the whole body counter on 3 occasions - - 3 days, 6 days and 10 days after the incident. Rechecks were required because his normal background had not been measured before the incident and a difference spectrum was needed to indicate the presence of gamma-emitting materials which are being cleared out of the lung. Repeated checks also indicate the rates of elimination from the lung. From day 3 to day 6 the average elimination rate was 5.9% per day, and then from day 6 to day 10 elimination rate averaged 4.2% per day.

The urinary excretion rates during the first 10 days for strontium and for cerium were evaluated on the basis of simplified distribution models. An estimate of the initial lung burden and of the rate of transfer from the lungs to the blood-stream was obtained from the urinary excretion data. A similar set of parameters was obtained from the fecal excretion rate data.

Strontium model:



- (1) Assume that 1/2 of the strontium reaching the blood goes to the bone and that the amounts in the urine due to a deposit in the bone are negligible.
- (2) Assume that the elimination constant for blood, λ_B , is much greater than that for the lung λ_L .

Under these assumptions the rate of strontium excretion in the urine may be related to the initial lung burden which can be estimated from the excretion rate data.

$$\dot{Q} = 1/2 \lambda_L I e^{-\lambda_L t} \quad (1)$$

Using (1), and the excretion data it was estimated that the initial lung burden of $\text{Sr}^{89} + \text{Sr}^{90}$ was 1.8 μc exclusive of the portion cleared from the lung via ciliary action and eventual excretion in the feces.

On the basis of the fecal data it was estimated that an additional 0.63 μc of $\text{Sr}^{89} + \text{Sr}^{90}$ was initially retained.

Results of radiochemical analyses of a number of representative samples agree that 93% of the strontium is Sr^{89} (estimate initially 2.26 μc) and 7% is Sr^{90} (estimate initially 0.17 μc).

During the first 10 days after exposure the average half-life for removal of strontium via the gastrointestinal tract was 0.7 days, and for removal via the bloodstream the half-life was 2 days. Since we have no previous similar exposures we do not know how much of the lung burden will be eliminated at this rapid rate. So, as an approximation, it was assumed that, of the 1.8 μc destined to move via the bloodstream, all of the activity remaining in the lung at the end of our available data (at 10 days approximately 25% still remains) was assumed to be fixed in place and only radiological decay was considered.

Using these approximations the first quarter dose to the lung was estimated to be 0.188 REM from Sr^{90} and 0.897 REM from Sr^{89} .

A similar model yields an estimate of the exposure to the bone for a given initial lung burden. In this case the total 1.8 μc was assumed to reach the bloodstream with an effective half-life of 2 days for Sr^{90} and 1.92 days for Sr^{89} , and the effective half-life in the bone was taken to be 2.7×10^3 days for Sr^{90} and 51 days for Sr^{89} . The dose to the bone for the first quarter was estimated to be 0.215 REM from Sr^{90} and 0.865 REM from Sr^{89} .

Estimates of initial lung burden of cerium were obtained from the excretion data and treated in the same general way as described for strontium. The following values were used:

- 56% of total cerium was Ce^{144} (estimate initially 0.60 μc)
- 44% of total cerium was Ce^{141} (estimate initially 0.47 μc)
- effective half-life, lung to blood: 3.56 days for Ce^{144} , 3.24 days for Ce^{141}
- approximately 93% excreted via feces with 0.7 day half-life
- 45% of cerium reaching bloodstream goes to bone, an equal quantity is excreted in the urine.

These approximations yield an estimate that the dose to the lung for the first quarter could total 0.074 REM for Ce^{144} and 0.009 REM for Ce^{141} . Estimates of dose to the bone are 0.061 REM from Ce^{144} and 0.003 REM from Ce^{141} .

Estimates of dose to the lung were obtained for La^{140} (initially $0.047 \mu\text{c}$; estimate 0.003 REM for the first quarter), for Ba^{140} (initially $0.041 \mu\text{c}$; estimate 0.007 REM for the first quarter), and for $\text{Zr}^{95}\text{-Nb}^{95}$ (initially $0.06 \mu\text{c}$; estimate 0.004 REM for the first quarter). The estimates of initial lung burdens were obtained from the relative amounts of the several isotopes present in samples from the exposure area by comparison with the estimates for cerium.

A solubility test was conducted to determine the rate of dissolution of the various materials in blood serum which was used to approximate the composition of lung fluids. A dust sample was immersed in blood serum contained in a semipermeable membrane bag which was suspended in a larger quantity of serum. The serum was kept at body temperature during the test and at intervals a mixture of $5\% \text{ CO}_2$ and air was bubbled through the serum to facilitate mixing. Small aliquots of serum were taken from the outer container at intervals out to 18 hours. The strontium was by far the most readily soluble of the radioactive materials. Strontium accounted for only 13.5% of the beta-activity in the original sample, whereas, within 18 hours strontium accounts for over 94% of the beta-activity in solution. After the first hour, the rate of movement of strontium into the serum phase was essentially constant at 1.48% per hour. It is interesting to note that this rate corresponds to a half-life of 1.95 days. This may be compared with the 2-day half-life for transport of strontium from lung to blood which was estimated from urine data.

The parameters used to obtain estimates of dose from cerium predict that from day 3 to day 6 the cerium lung burden should decrease by $0.063 \mu\text{c}$. Whole body counter measurements made on those days show the decrease to be $0.060 \mu\text{c}$.

To date, all of the estimates of exposure to the lung, whether based upon excretion data or whole body counter measurements, indicate that [redacted] will receive at least 3 times more exposure than the next highest man. It appears probable that none of the other men will receive a radiation dose in excess of that of [redacted], so a less detailed treatment of their dose estimates may be acceptable. The available data for each man has been compared to that of [redacted] and proportional dose estimates obtained.

[redacted] strontium excretion curve is parallel to that of [redacted] and is lower in magnitude by a factor of 4.05. All of the dose estimates directly proportional to the amount of strontium will be assigned accordingly.

[redacted] cerium excretion curve is parallel to that of [redacted] and is a factor of 3.2 lower in magnitude. This factor applies to all dose estimates except those for strontium.

Only two urine sample results and one fecal sample are available for comparison of strontium excretion rates. The two urine results lie close to a line which is parallel with [redacted] strontium excretion results and a factor of 10.8 lower.

Only one urine sample was analyzed for cerium (factor of about 25 lower than [redacted]). However, by comparing the amounts of cerium indicated by the whole body counter it is seen that [redacted] is a factor of 11 lower than [redacted].

All dose estimates for [redacted] are taken to be a factor of 11 lower than for [redacted].

There are only 3 urine sample results presently available for comparison, however both cerium and strontium excretion rates appear to be similar to, but a factor of 12 lower than that of [redacted]. This factor is confirmed by the whole body counter results which are a factor of about 15 lower than for [redacted]. Dose estimates assigned to [redacted] are a factor of 12 lower than for [redacted].

[redacted] an employee of National Carbon Company

Only one urine sample and one fecal sample were obtained from [redacted]. He returned to his home office before it was possible to schedule a measurement with the whole body counter. [redacted] is planning to return within the next week and we have scheduled a time for him to visit the Y-12 whole body counter. On the basis of his single urine sample he is excreting strontium a factor of 12.9 lower than [redacted]. For the present time this is all we have to use for estimating his internal dose.

There is very little data concerning the next three men except for a single whole body counter measurement and one or two urine samples for each man. However, all indications are that their exposures were much lower than that estimated for [redacted].

Dose estimates are a factor of 22 lower than for [redacted] based upon one urine sample and a whole body counter measurement.

There is much variation in the excretion data of this man. It appears that his total exposure is a factor of about 65 lower than [redacted]. However, additional body counter measurements will be necessary in order to rule out the possibility of a re-exposure since the last check.

[REDACTED] exposure appears to be very low on the basis of both urinalysis and body counter data. His estimated dose is a factor of 150 lower than that of [REDACTED]. There is no indication that additional special study should be continued for this man except for routine monitoring.

Summary

It should be well understood that the estimates of internal dose given in the attached table are interim estimates pending more complete data. It is known, for example, that whereas the radioactive lung burdens of some of these men are quite uniformly spread throughout the lung area, at least one man seems to have a significantly greater deposit in the right lung. We will continue to study the exposures of [REDACTED], [REDACTED], [REDACTED] and [REDACTED] with the whole body counter until we can more adequately define the body burdens and their rates of elimination.

**Current Estimates of Internal Dose
(Preliminary)**

	<u>Lung</u>		<u>Bone</u>	
	1st Quarter	1st Year	1st Quarter	1st Year
	REM	REM	REM	REM
██████████	1.18	2.09	1.14	2.24
██████████	0.30	0.93	0.29	0.56
██████████	0.11	0.19	0.10	0.20
██████████	<0.10	0.17	<0.10	0.19
██████████	<0.10	0.16	<0.10	0.17
██████████	<0.10	<0.10	<0.10	0.10
██████████	<0.10	<0.10	<0.10	<0.10
██████████	<0.10	<0.10	<0.10	<0.10

Questions asked by Joe Lenhard on May 6, 1960 concerning the Solid State Incident:

1. What was the occupation of the people who were contaminated?

Answer: [REDACTED], Laboratory Technician
[REDACTED], Laboratory Technician
[REDACTED], Development Engineer
[REDACTED], Physicist
[REDACTED], Chemist
[REDACTED], Development Engineer
[REDACTED], Associate Physicist
[REDACTED], Visitor from National Carbon Company

The names of the above were not asked for and were not given.

2. What is the radiation history of the fuel element that was cut in Cell No. 1?

Answer: 1400 hrs in the MTR at power; 14.7% atom burnup; removed January 25, 1960.

3. Are heating ducts the same as the air conditioning ducts?

Answer: Yes

4. How many of the 65 people in the building had bio-assays taken?

Answer: Urine specimens were taken from all but they have not all been analyzed as yet.

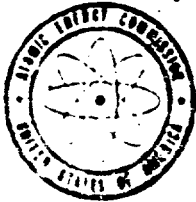
5. How many of the 65 had clothing contamination?

Answer: According to [REDACTED], 17 people had some contamination to the extent that they left part of their clothing for laundry. This consisted of various items such as shirts, shoes, etc. In addition to these 17 people, an undetermined number had a slight amount of contamination which was removed and the people were allowed to continue on their way.

WHJordan:dwh
May 6, 1960

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to the public by:

David R. Hamm 12/15/95
Technical Information Officer Date
ORNL Site



UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

MAY 10 1960

Mr. James T. Ramsey
Executive Director
Joint Committee on Atomic Energy
Congress of the United States

Dear Mr. Ramsey:

This will provide information on the incident in the Solid States building (3025) at the Oak Ridge National Laboratory on April 26, 1960 to supplement that telephoned to the Joint Committee staff on April 27th and that which was provided in a copy of the May 3rd Oak Ridge press release transmitted to the Joint Committee by our letter of May 5th.

At about 7:00 a.m., April 26th, an experimental graphite fuel element was being sawed in Cell No. 1. There were eight people immediately in front of the cell remotely controlling or observing the operation through a glass panel. Approximately five additional people were in the area in front of the cell working on other cells and on other operations. About 52 other people were in the building at the time of the incident, mainly in the office areas.

Bio-assay samples have been taken from all of the 65 persons who were in the building at the time of the accident, but analyses have been completed only for the eight persons in the immediate vicinity of Cell 1. The balance of the assays will be completed within the next ten days. In view of the data obtained on the persons thought to have received the highest exposures, no significant body burdens are expected to be found in the other persons. The assays are being performed as a precautionary measure.

There are no noticeable physical effects in any of the exposed persons and none are expected. The exposed persons are continuing to work, but have been assigned to non-radiation areas at the Laboratory.

The maximum film badge reading for any of the exposed persons was 120 millirads of gamma radiation. This reading represented total gamma exposure since April 1, the date the film badges had last been changed. The maximum permissible exposure for radiation workers is 3,000 millirads per quarter; or a cumulative average of 5,000 millirads per year for persons over 18 years old.

Seven of the eight persons who were in front of Cell 1 have been measured at least once in the whole-body counter. The eighth, an employee of

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Donald R. Hamm
Technical Information Officer
ORNL Site

Date

4643
MAY 12 1960

National Carbon Company of Cleveland, Ohio, has had one urine sample and arrangements are being made to take additional urine samples and to measure him in the whole-body counter.

The radioactive material inhaled by the eight persons who were in front of Cell No. 1 appears to be localized in the lungs. The extent of the internal exposure cannot be determined precisely until further measurements are taken over a period of several weeks. Pending these measurements and on the basis of the data now available, estimates of doses to the lungs have been made using two different assumptions. If it is assumed that all of the material taken into the lungs will remain there permanently, the highest estimated exposure to the lungs would be about 2 rns. If it is assumed that half of the material in the lungs will be removed each 30 days, the highest estimated exposure would be slightly more than 1 rm. Under either assumption, the other seven persons had an estimated exposure of less than one-fourth rm. All of these exposures may be compared with the quarterly permissible dose to the lungs which is 4 rns.

The measurements made to date indicate that the material has a half-life of less than 30 days in the lungs; therefore, the estimated exposures probably are higher than actual exposures. The estimated lung doses for seven of the eight persons under the assumption of permanent retention (condition 1) and the assumption of 30-day half-life in the lung (condition 2) are tabulated below:

<u>Employee</u>	<u>Condition 1</u> (in rm)	<u>Condition 2</u> (in rm)
a.	1.9	1.2
b.	.23	.14
c.	.18	.11
d.	.13	.08
e.	.09	.05
f.	.03	.02
g.	.03	.02

The eighth person exposed was the National Carbon Company representative whose single urinalysis indicates his exposure is somewhere between employee d. and e. One person (designated as case b, above) appears to be more concerned about the incident than the others, to the extent that he has had several talks with the plant physicians.

At the time of the incident, the top slab had been removed from Cell No. 2, adjacent to Cell No. 1, for modification work. Connecting the two cells are five large openings. In addition, there were two smaller openings in the face of Cell No. 1 opening into the space in front of it. These were shielded against direct radiation but not hermetically sealed. The presence of these openings and the fact that the top slab of Cell No. 2 was not in place created a pressure differential between Cell No. 1 and the space in

front of it which was less than it would have been if the top slab had been in place on Call No. 2 and the openings plugged against air passage. At the time of the incident there was a 5 to 7 mph wind blowing outside and a door behind Calls 1 and 2 was open to the outside. With these conditions existing, it appears that wind blowing through the opened door created a positive pressure in the opened Call No. 2 which was transmitted through the wall openings to Call No. 1. The pressure in Call No. 1 then became positive to the extent of forcing contaminated graphite particles from the fuel element through the small openings in the face of Call No. 1 into the space where the operators, observers and others were present.

Some of the escaping graphite particles lodged in a continuous air monitor which gave audible and visual indications of radiation activity. The employees in the call area continued to work until an employee in an adjacent office heard the alarm and called the health physics surveyor to the scene. Two health physicists arrived between two and ten minutes after the alarm sounded, checked the monitor filter, determined that a radioactive release had occurred, and ordered the building evacuated.

One health physicist was posted at an outside door to check each person for contamination. Those who were found to have external contamination were routed to a decontamination area in the basement. After providing himself with an airmask, the other health physicist returned to the space in front of the calls and evacuated one or two employees still working in an attempt to seal the openings.

The eight employees who had been working in front of the calls were found to have clothing contaminated in the range of 20 mr per hour. In addition to the eight, approximately ten other persons were found to have small particles of contamination on their clothing. This clothing was taken, the contaminated people showered and then re-checked before being allowed to leave the building. A few had nose contamination and were sent to the medical division for nose rinses. All external personnel contamination was cleaned up very readily and without difficulty.

Health physics surveys within a few hours of the incident revealed that the floors of office areas as well as operating areas were contaminated. It was first assumed that this contamination had been tracked around the building since there was no wall or desk contamination at that time. However it is now believed that the unusual air flow pattern within the building carried the contaminated graphite particles from the areas immediately in front of the calls down an adjacent stair wall and into the basement of an office section of the building where it entered the intake of the office air conditioning system. The intake filter on this air conditioning system was of the normal type but was plugged and had ruptured. The contaminated material drawn into the office air conditioning system apparently therefore was slowly re-circulated throughout the office section of the building.

The contamination was confined to the inside of Building 3025. Rough cleanup of both the cell and the office sections is now complete except for the basement and the first floor of the cell side of the building. This was done by vacuum cleaning and by scrubbing with detergents, where necessary. Occasional particles of contamination reading from one to ten mR per hour are being found. The air conditioning system duct work is contaminated but has been provided with filters on both intake and output openings. Air concentration levels in the building are now one-third hundredths of that permissible for strontium 89. The air conditioning system has been operating since approximately 3 a.m., Thursday, May 5th and is apparently not re-contaminating the building.

If the air conditioning system does not re-contaminate the building, the estimated cost of cleanup will be approximately \$30,000. If the air conditioning system is found to re-contaminate the building, it will also have to be de-contaminated and the total cost of cleanup will be about \$60,000. In the first case, it is expected that cleanup of the offices can be accomplished this week. If the air conditioning system requires decontamination, about one month will be required. All employees of the building have been and will continue to be assigned elsewhere in the Laboratory until the Solid States building can be re-occupied.

A thorough investigation of the incident has been undertaken to determine what remedial measures should be taken. In the interim, all cells are being equipped with a pressure alarm system which will operate at less than .2 inches water gage negative pressure with respect to occupied working areas. Operating regulations will be revised to assure that cells are not operated with less than the specified accepted pressure differential.

The fuel element, which was an experimental sample element designed by National Carbon Company, is graphite clad over a uranium-carbide dispersion in graphite. The uranium is fully enriched. The sample had been irradiated in the MTR for 1400 hours and had 14.7% burn-up. It is important to note that, at the time of the incident, the sam had not reached the interior of the element, but only the outer cladding. The fission products identified in the contamination are mainly those with gaseous precursors, i.e., cerium-141 and strontium-89. The analysis of the contamination is presently estimated as follows:

- a. Beta activity: 15% strontium (90% strontium-89, 10% strontium-90)
 - 20% rare earth
 - 55% cerium 141
 - 10% mixed beta activity

James T. Roney

- 5 -

b. Gamma activity: 85% cerium 141
15% cobalt 60, zirconium 95 and niobium 93

No plutonium was detected.

Sincerely yours,

SIGNED, A. R. LUEDECKE
General Manager

Kak. 4 p. -
Account -
Question from 1 member
Ans. by FRB, W.H. etc.
Date: ~ 4-56

1. Q. What is the current condition of the exposed people?
A. There is no evidence of somatic effects.

2. Q. What is the present estimate of the extent of their exposure?
A. The present estimate is that the high man has an exposure of 1 rem for the quarter, vs. the 1.3 average allowable exposure and the 3 rem maximum allowable exposure for the quarter. The second and third highest exposures are a factor of 10 less; the balance lower by a factor of two or three.

3. Q. What is being done to pinpoint the extent of exposure? Have exposed people been removed from the job? Have they received any sort of treatment? If so, what?
A. Daily urine and fecal samples on all of the men are being taken. The highest and third highest man are being given multi-examinations of the radioactivity in the whole body counter. Solubility measurements/on graphite particles, representative of those ingested, are being made in body fluids. Particle size measurements are also being made to assess elimination rates. The men will be restricted from areas where a second exposure would be possible. This restriction will be Further action will depend on the dose. in effect until the exact dose is known./ They have received no treatment.

4. Q. What is the current status of contamination inside, outside, and in surround areas?
A. The current status inside the building is as follows: The air activity is in the range of 10^{-11} - 10^{-12} $\mu\text{C/cc}$ as opposed to maximum permissible concentration of 3×10^{-8} for Sr^{89} . All

areas of the new building have been probed and those spots having detectable contamination have been cleaned up. An extensive smear program is now being carried out to determine the necessity for further decontamination. The same is true of the old building, except for the Hot Cell area which remains highly contaminated.

5. Q. What decontamination methods are being employed?
A. Vacuum cleaning is very effective. Where this is not effective, scrubbing with Fab is employed.
6. Q. What is current estimated time of clean-up?
A. (1) If the air conditioning system does not give rise to any air-borne activity, the new building is expected to be occupied next week. The old building is expected to be occupied the following week.
(2) If the air conditioning does give rise to air-borne contamination, it may be cleaned using industrial heating and ventilation vacuum cleaning techniques. This would take three to four weeks.
7. Q. What is current estimate of cost of clean-up?
A. In the first case above, approximately \$30,000; in the second case, approximately \$60,000.
8. Q. What facilities are closed down? How long will these remain closed?
A. All personnel have been evacuated from Bldg. 3025 and all operations, except clean-up, ceased.

9. Q. What is the effect of the close-down on operations?

A. Of the 10 people in the Solid State Division, 69 have been removed to other quarters as a result of the building shut-down. The work involving the use of the Bldg. 3025 hot cells for solid state studies has stopped. If operations are resumed according to schedule (1) of Question 6 above, report writing and activities carried on in other facilities will permit over-all operation of the Division with 75% efficiency during this period.

10. Q. Is an investigation being made? If so, when will the report be available?

A. Yes. The report will be available in about a month when the results of the clean-up and personnel exposure are obtained.

11. Q. Just how did reversal of air flow happen? Need an up-to-date story of what occurred.

A. The essential elements involved in the incident are:

(1) Cell 1

(2) Cell 2, adjoining cell 1 and connected to it by a transfer port

(3) The roof plug of cell 2 which was removed at the time of the incident.

(4) The cell access area north of the cells containing a door to the outside which was open, and

(5) The operating area on the south side of the cells.

It is believed at present that the negative pressure in cell 1 was abnormally low, a few hundredths of an inch of water, because-

of the roof plug on cell 2 having been removed. A gust of wind is believed to have entered the door on the north side of the cell access area with subsequent pressurization of cell 1 via the cell access area and cell 2. This resulted in the release of air-borne activity through the penetrations in the operating face of cell 1.

12. Q. What will be done to remedy the situation leading to incident?

A. All cells used for such operations will be required to have a minimum of 0.2 inch of water negative pressure. All operations are being required to set up more stringent operating procedures which would preclude the possibility of loss of cell negative pressure and conditions leading to pressurization. All cells will be equipped with an alarm to indicate when the pressure differential is less than -0.2" H₂O.

13. Q. What inquiries have been received from newsmen and how are these being handled?

A. None have been received at ORNL.

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to the public by:

David R. Hamner 12/15/95
Technical Information Officer Date
ORNL 3116

UNITED STATES

ATOMIC ENERGY COMMISSION

Oak Ridge, Tennessee

Information for Press, Radio and TV (No. 701)

FOR IMMEDIATE RELEASE

Telephone No.
Oak Ridge 5-8611
Extension 4231

SLIGHT RISE IN RADIATION LEVEL RESNETS
IN EVACUATION OF BUILDING AT ORNL

A slight rise in the radiation level in the Solid States Building at the Atomic Energy Commission's Oak Ridge National Laboratory resulted in evacuation of the building about noon yesterday (April 26). There is no evidence of overexposure of personnel to radiation.

The radiation monitors sounded when a change in the internal air flow in the building carried radioactive particles -- consisting of graphite contaminated largely with cerium and strontium -- from a process cell into other areas of the building. The particles emitted primarily beta radiation, which is non-penetrating. None of the contamination escaped the building.

The particles came from a graphite-impregnated irradiated fuel element which was being examined in the cell.

Readings made shortly after the monitors sounded indicated slight contamination of floors and personnel. Eight persons were working in the area and were slightly contaminated. Due to the nature of the particles, personnel decontamination was relatively simple. Some clothing and shoes were taken to the decontamination area.

Cleaning operations are in progress and will be completed by 4:00 p.m. today.

UNITED STATES
ATOMIC ENERGY COMMISSION
Oak Ridge, Tennessee

Information for Press, Radio and TV (No. 706)
FOR IMMEDIATE RELEASE

Telephone No.
Oak Ridge 5-8611
Extension 4231

EIGHT EMPLOYEES AT ORNL
CHECKED FOR INTERNAL EXPOSURE

Eight persons who were in the immediate vicinity when radioactive material was released in a building at the Atomic Energy Commission's Oak Ridge National Laboratory April 26, inhaled some contaminated particles.

The AEC's Oak Ridge Operations said today that studies, which may take several weeks, are in progress to determine the extent of internal exposure to these individuals.

The material was released in the Solid States Building at ORNL when a change in the internal air flow in the building carried radioactive material out of a cell in which an irradiated fuel element was being examined. The radioactivity, consisting of graphite containing some cerium and strontium, was confined to the building.

Both cerium and strontium emit primarily non-penetrating beta radiation.

The eight persons working in the immediate area received some contamination and went through normal decontamination procedures.

After the incident, film badges worn by these individuals indicated a maximum reading of 120 millirads of penetrating radiation. However, this figure represented the total penetrating radiation received since April 1, the date the film badges were last changed. The maximum permissible dose is 3,000 millirads quarterly.

This document has been approved for release
to the public by

David A. Jones
Technical Information Officer
ORNL

The cleanup of the building has been complicated by some radioactive material which got into the building's air-conditioning system. The air circulation spread the material through the building and its ventilation system.

The time required for cleanup will depend largely on the amount of work required on the air-conditioning system.

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